

Article

A Study of Farmers' Behavior in Classifying Domestic Waste Based on the Participants Intellectual Decision Model

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Abstract: The farmers' deep participation in the classification of domestic waste plays a crucial role in reducing the amount of waste out of the village from the source, lowering the cost of waste treatment, and realizing the sustainable development of rural waste resocialization, reduction, and harmlessness. This paper aims to identify the key factors and logical structure that influence the farmers' behavior in classifying domestic waste and provide recommendations for improving it. Based on the Participants' Intellectual Decision (PID) Model, we constructed a theoretical analysis framework for farmers' decision-making on domestic waste classification, and the PID model was further extended by combining with the practice of rural domestic waste management in China and proposing the research hypothesis that factors, such as community attributes, rules of operation, the status of the participants, and the situation of external actions, have a significant impact on the farmers' behavior in classifying domestic waste. Empirical analyses were carried out with the help of the ordered logistic model and the DEMATEL-ISM using 939 research data of farmers in Jiangsu and Gansu provinces of China. The results show the following: (1) classification of domestic waste by farmers in the sample area was predominantly unclassified (34.40%) and two-classified (40.58%); (2) 17 factors, including regional disparity, Party affiliation, organizational support perception, environmental emotions, conscious governance attitudes, trust in village cadres, social reference norms, and expected outcomes, have a significant impact on the farmers' behavior in classifying domestic waste; (3) trust in village cadres, organizational support perception, and environmental emotion are superficial direct factors; incentive measures, fee level, waste transport situation, difficulty perception, self-consciousness perception, social reference norms, and expected outcomes are middle indirect factors; whether or not it is a demonstration village, Party membership and regional disparity are deep root factors affecting farmers to classify their domestic waste.

Keywords: classification of domestic waste; participants' intellectual decision model; DEMATEL-ISM



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1. Introduction

Rural domestic waste management is an important measure to achieve rural revitalization and ecological livability, as well as the construction standards of beautiful countryside and beautiful China. With the continuous development of the rural economy and the substantial improvement in the material living conditions of the residents, the production of rural domestic waste has been increasing, and the composition has become more and more complex [1]. According to relevant research predictions, the average daily domestic waste produced by each person in rural China ranges from 0.24 to 1.2 kg, and the annual domestic waste output will reach 0.52 to 2.76 million tonnes. Such a massive amount of domestic waste discharge damages the local living environment and threatens the quality of arable land, groundwater safety, and even the health of rural residents. It is urgent to promote the reducing, reusing, and recycling of rural domestic waste at source, and classification at source is both a prerequisite and a key.

As waste is an inevitable outcome of daily life, it is crucial for individuals to participate in domestic waste management [2]. For a long time, the administrative order type has been a financial push type and “one size fits all” type of governance, so the farmers did not pay much attention to the classification of waste; the government’s style of taking care of everything also makes farmers generally lack “ownership” consciousness, undoubtedly exacerbating the lack of participation in the problem of farmers. Therefore, the sustainable governance of rural domestic waste classification should prioritize solving the governance dilemma of the collective inaction of farmers [3].

How can we promote the classification of domestic waste among farmers? It is widely recognized that waste classification is “a complex process” [4] and that multiple factors influence individual classification behavior. Such factors are the policy system [5,6], social environment at the macro level [7], and individual characteristics at the micro level. Specifically, the academic community mainly from the sociological and psychological perspectives, based on the theory of planned behavior [8], the norm activation theory [9], the A-B-C theory [10], the KAP theory [11], the MOA theory [9], etc., explored the individual features of farmers’ characteristics, psychological cognition, behavioral attitudes and other personal endowments, subjective factors and social capital [12], institutional regulations [13], external interventions [14], infrastructure support [15,16], tools and technology utilization [17], spiritual ecology activism [18], and many other external environmental factors on the individual’s domestic waste classification, including the willingness to classify [19], preference for classification [20], level and effect of classification [21], the paradox of willingness and behavior [22], etc.

Existing studies analyzing influencing factors of domestic waste classification have laid a sound research foundation for this paper. However, there are still the following shortcomings. Firstly, existing studies have focused on examining the influence of a few factors on the classification of domestic waste by farmers, and there is a lack of systematic analysis of the influencing factors under the unifying framework, which leads to the fragmentation of the findings of this study and seriously affects the depth of this study. Secondly, micro-level studies focus on the exploration of factors influencing the willingness of farmers to classify waste, but in reality, willingness is much higher than the actual situation. Thirdly, the influencing factors of domestic waste classification may have an interdependent relationship with each other. Some studies have put more emphasis on the causal relationship between the factors and the behavior of farmers in the classification of domestic waste, ignoring the hierarchical structure and logical relationship between the factors themselves, making it more challenging to form scientific and objective conclusions of the research.

Therefore, this paper is based on the research objective of systematically sorting out the influencing factors of the classification behavior of farmers, clarifying the logical relationship and hierarchical structure of the influencing factors, and trying to make the following improvements. Firstly, this paper combines the practice of rural domestic waste management in China, adopting holistic thinking to systematically sort out the many factors that may affect farmers’ classification behavior and constructing the analytical framework of this paper based on the expanded PID model. Secondly, focusing on the classification behavior of farmers, after empirically extracting the core key factors affecting farmers’ classification behavior, we explore the interrelationships and hierarchical structure among the influencing factors, clearly showing the logical relationship and driving mechanism among the influencing factors and analyze the root causes and superficial constraints to address the collective action dilemma of the governance of living garbage classification in a targeted way.

The marginal contributions of this study are reflected in the following. First, it makes up for the lack of existing research that only analyzes the determination of the factors influencing the significance of farmers’ garbage sorting behavior and the direction and degree of their influence but further analyzes the correlation relationship and hierarchical structure among the factors. Second, environmental emotion, environmental attitude,

difficulty perception, and government support were first incorporated into the traditional PID model to develop and validate the extended PID model for the study of farmers' garbage sorting behavior model. Third, the dimensional boundaries of environmental emotion are expanded, thus enriching the theory of the relationship between environmental emotion and individual behavior. Existing considerations of environmental emotions have focused on individual emotional responses triggered by positive or negative events, neglecting the fact that individuals' emotional needs arise not only from self-affirmation but also from recognition by others.

2. Theoretical Analysis and Research Hypotheses

The Institutional Analysis and Development (IAD) framework is a classic analytical framework developed by Ostrom based on Olson's theory of collective action to explain the participation of actors in public affairs under collective action [23,24], and it is a classic paradigm for empirical research on the collective action problem of resource appropriation and supply in public ponds. The most central concept in the IAD framework is the arena of action [25], and the Participants Intellectual Decision (PID) Model is the core of the action arena [26]. The central idea of the PID model is that in addition to the natural material and institutional environments, factors affecting participants' behavior also include the participants' situation, the degree of perception of the status quo of the action, and the expectation and conditional control of the outcome [27].

Currently, the waste classification and management program in rural areas of China focuses on waste generated by farmers in their daily lives, including perishable, recyclable, non-recyclable, and hazardous waste. It excludes waste generated by agricultural production and rural construction. The most efficient way of classifying waste in rural areas is for individual classification to lead to collective action, that is, for each village member to classify the household's domestic waste.

Therefore, this paper focuses on farmers' classification decision-making in the collective action of rural domestic waste classification. Starting from the connotation of the PID model and drawing on the results of related studies, we adaptively adjust the PID model. We integrate natural attributes, conditional control, community attributes, operating rules, participant's situation, perception of the status quo, external action situation, and expected outcomes into the analytical framework of the PID model that influences the behavior of farmers in classifying domestic waste (Figure 1).

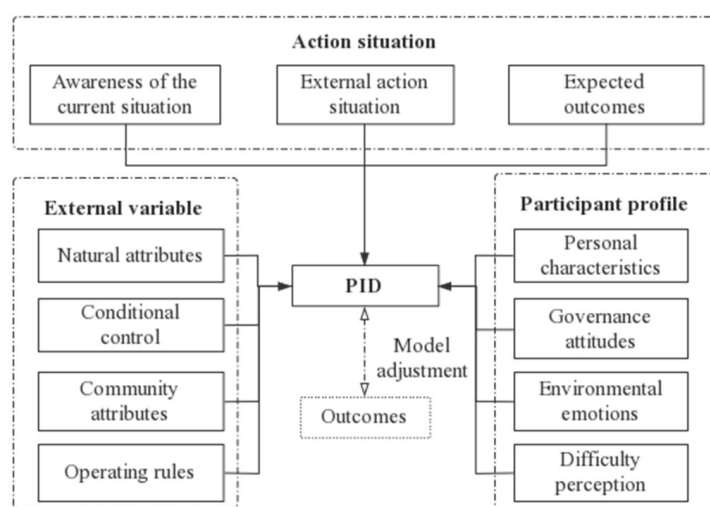


Figure 1. The expanded participants' intellectual decision model.

2.1. Natural Attributes

The natural features of a region mainly relate to its resource availability and location characteristics. Ostrom has pointed out that the community's natural characteristics

will directly impact the stage of action. Altitude, distance from cities, and terrain significantly impact population density and the distribution pattern. This directly influences the development of protocols for classifying waste, creating transportation programs, and treating waste centrally [28,29]. Furthermore, China's hierarchical management system and traditional order patterns result in local governments choosing between protecting the environment, developing rural resources, and promoting local economic growth based on natural differences. Thus, the dissimilarities in the innate features of villages partly decide the formation of the mechanism for managing domestic waste in villages and the degree of administration assistance [13], which consequently shapes the classification habits of farmers.

Hypothesis H1. *The natural characteristics of the village significantly influence farmers to classify their domestic waste.*

2.2. Participant Status

Farmers play a crucial role in the classification of domestic waste at the front-end stage of domestic waste management. Farmers' behavior in classifying domestic waste is influenced not only by their characteristics but also by individual perceptions, such as attitudes toward governance, environmental emotions, and perceptions of the difficulty of waste classification, among others.

2.2.1. Personal Characteristics

Personal traits are specific to an individual's background, and previous research identifies participant status through factors like age, gender, and political affiliations [30]. Typically, the older the person, the more likely they are to hold traditional views. Classifying waste may be more challenging for them due to the intricacies of its composition. In line with the "all work led by the Party" policy in China, Party members often assume a guiding position in rural public issues, setting an example for others and intentionally making strides in waste segregation. However, some experts have discovered that the effects of these factors may vary [31,32]. In this study, we incorporate the individual characteristic attributes of farmers as control variables in this model.

2.2.2. Governance Attitudes

Attitudes are stable psychological dispositions individuals hold toward particular objects (people, ideas, emotions, events, etc.). This psychological tendency implies the individual's subjective evaluation and behavioral predisposition. In this era of easy access to information, it is essential to provide information on knowledge of waste classification and raise awareness of waste pollution and responsibility for environmental management [33]. Having a higher sense of responsibility for environmental management means that, in addition to personal gains and losses, the positive significance of one's behavior on the environment will significantly influence farmers' attitudes toward domestic waste management and promote their domestic waste classification [30,34].

Therefore, we propose:

Hypothesis H2a. *Governance attitudes positively influence farmers to classify their domestic waste.*

2.2.3. Environmental Emotions

Environmental emotion is an individual's psychological reaction or attitudinal experience to environmental issues or whether the goal of pro-environmental behavior meets his or her needs and directly affects the individual [35]. The two-factor theory of emotion-behavior suggests that positive environmental emotions can lead individuals to engage in more pro-environmental behaviors and derive a sense of pride and enjoyment from them. And the behaviors are continuously reinforced to maintain this sense of enjoyment. Negative emotions can lead to cognitive dissonance and psychological distress, and in

order to reduce the gap between actual behavior and psychological commitments and to alleviate distress, individuals will automatically adjust their behavior patterns, i.e., abandon economically optimal choices and engage in socially and ecologically beneficial behaviors [36]. Farmers' participation in domestic waste classification can achieve waste reduction at source, and the behavior is in line with national ecological awareness and traditional ecological values, which predictably benefits environmental protection and social welfare improvement, thus stimulating farmers' pride, joy, and sense of accomplishment.

Therefore,

Hypothesis H2b. *Environmental emotion positively influences farmers to classify their domestic waste.*

2.2.4. Difficulty Perception

Objective conditions, such as whether participants have the energy, mastery of waste classification standards, and other self-assessments of competence, as well as the convenience of participation, can influence farmers' classification behavior [37]. The Theory of Planned Behavior states that an individual's perceived difficulty or sense of control and competence in performing a specific behavior impacts their behavior directly. The more farmers perceive that they can cope with the challenges of classification knowledge and the constraints of the code of conduct, the more likely they are to participate in waste classification [38].

Therefore, we propose:

Hypothesis H2c. *Perceived difficulties negatively influence farmers to classify their domestic waste.*

2.3. Conditional Control

Studies have been conducted to represent conditional controls mainly in terms of family characteristics, which mainly include the effects of household size, education, and economic level on farmers. There are still differences in the effects of the above factors on the domestic waste classification of farmers. For example, it has been pointed out that the number of households significantly and positively affects the level of participation in domestic waste management of farmers [39], with lower-income households having a higher classification level relative to higher-income households [40]. However, it has also been shown that classification behavior is not significantly correlated with the monthly income of the household [41]. The annual household income and the actual resident population of farmers do not have a significant impact on the farmers' classification behavior [31]. So, we incorporate the household characteristics as control variables in this model.

2.4. Community Attributes and Operating Rules

2.4.1. Community Attributes

Community attributes mainly refer to the community's attributes as distinct from its natural attributes. Community attributes generally include the degree to which participants identify with the community, the level of trust among community members, and the possession of community resources. Good community attributes often imply that community members share common beliefs and needs that provide a basis for collective behavior [38]. The establishment of trust among community members helps to increase individuals' sense of cooperation, which leads to the realization of collective action and then to the achievement of community members' common goals [42], which leads to a reasonable expectation of the outcome of collective action [43]. The more adequate the supply of resources needed to realize the action goal, the easier it is to achieve it.

Therefore, we propose:

Hypothesis H3. *Community attributes of villages are positively influencing farmers to classify their domestic waste.*

2.4.2. Operating Rules

Operating rules are regulations that members of a group need to follow together. Operating rules provide actors with cognitive templates, categories, and patterns essential to their behavior to determine the norms and obligations of their actions in waste classification. These rules imply the common understanding of the group in a rural society, affecting the actors' behavioral preferences and self-identity, thus influencing the behavior of individuals. Moreover, the rules can clarify the enforcement mechanism and the reward and punishment mechanism in collective action and provide other participants with information to intervene in the psychological tendency of the actors and guide their behavior. Among them, the reward mechanism motivates villagers to participate in domestic waste classification voluntarily [44], while the behavior of members who do not obey the action guidelines may lead to punishment or social sanctions [45], which have a positive impact on waste classification [46].

Therefore, we propose

Hypothesis H4. *Operating rules significantly influence farmers to classify their domestic waste.*

2.5. Perception of the Current Situation

From the perspective of product–institution analysis [47], the lack of good treatment of domestic waste in the village area is likely to exacerbate environmental pollution and lead to a “tragedy of the commons”. The government's involvement is important due to the positive externalities of domestic waste management. Instrumental support provided by the government, such as publicity and education, technical advice, and infrastructure construction, can reduce the difficulty of participating in domestic waste management. Farmers' perception of whether the government attaches importance to rural development and needs and respects and protects farmers' rights and interests and other emotional support can effectively activate the individual's reward psychology, resulting in the psychological drive to respond to the government's call to work hard to achieve the governance goals and behavioral tendencies [48], which, in turn, promotes the individual's participation in the action of waste classification.

Therefore, we propose:

Hypothesis H5. *The current situation of domestic waste management significantly influences farmers to classify their domestic waste.*

2.6. External Action Situation

Since farmers have lived in a relatively homogeneous village area for a long time, based on the social embeddedness theory, farmers' decisions are greatly influenced by the decisions of other farmers [12]. In the academic world, the behavior of others is considered a social reference norm in the external context variable [49]. If other farmers are also actively involved in domestic waste classification, it is conducive to forming a positive atmosphere of participation and promoting individual classification behavior [38]. Cohort behavior is an essentially social context in which an individual is situated, and aligning with most farmers is a way to seek a sense of belonging and security in the community [50]. At the same time, the cohort effect also creates endogenous pressure on farmers to restrain their environmentally harmful behavior [51].

Therefore, we propose:

Hypothesis H6. *External action situations positively influence farmers to classify their domestic waste.*

2.7. Expected Outcomes

Rational Decision Theory and Expectancy Theory suggest that expected outcomes are important antecedent variables in decision-making [52,53]. Individuals' behavioral motivation comes from both the likelihood of achieving the action goal and the expectation

of the outcome [26]. Classification of domestic waste can, on the one hand, reduce the pollution of soil, air, and water. It is caused by domestic waste and reduces the health risk of current environmental pollution to farmers; on the other hand, it can also increase farmers' resource utilization of domestic waste or gain from selling recyclable waste. Good environmental improvement results can increase farmers' confidence in implementing the waste classification system; on the contrary, farmers' participation in managing domestic waste classification enthusiasm will also significantly reduce [44].

Therefore, we propose:

Hypothesis H7. *Expected outcomes of collective action positively influence farmers to classify their domestic waste.*

3. Materials and Methods

3.1. Research Methods

3.1.1. Ordered Logistic Models

Because the classification level has prominent hierarchical characteristics, this paper uses an ordered logistic model for regression analysis. Ordered logistic regression involves splitting ordered multi-categorical variables into multiple dichotomous dependent variables, fitting multiple dichotomous logistic regressions, and constructing a regression model based on cumulative probabilities. In this paper, based on existing research [40], the farmers' classification behavior of domestic waste is classified into four types of classification, such as no classification, two-classification, three-classification, four-classification, etc., and then the dependent variable is split into three binary logistic models: 1 vs. 2 + 3 + 4, 1 + 2 vs. 3 + 4 and 1 + 2 + 3 vs. 4. The model is set up as follows:

Assume $y^* = x'\beta + \varepsilon$ (y^* is unobservable), and the selection rule is

$$y = \begin{cases} 1, & \text{if } y^* \leq r_0 \\ 2, & \text{if } r_0 < y^* \leq r_1 \\ 3, & \text{if } r_1 < y^* \leq r_2 \\ 4, & \text{if } r_2 < y^* \end{cases} \quad (1)$$

Here, $r_0 < r_1 < r_2 < r_3$ is the parameter to be estimated, called "cutoff points". y denotes the domestic waste classification of the sample farmers. x' denotes the influencing factor variables in the previous section. β is the coefficient of the independent variable, and ε is the random disturbance term. The statistical software SPSS 23.0 was used to estimate the ordered logistic model to obtain the significance of the influencing factors on the domestic waste classification of the farmers, where β is positive for positive influence and vice versa for negative influence.

3.1.2. DEMATEL-ISM

The ordered logistic model can effectively screen the significant influencing factors among many variables but cannot test the correlation among many influencing factors. In contrast, the Interpretative Structural Modeling (ISM) Method can reveal the hierarchical structural relationships among the influencing factors [54]. Since ISM models require a large number of matrix operations, the combination of the Decision-making Trial and Evaluation Laboratory (DEMATEL) method and ISM can effectively simplify the computational process of constructing reachable matrices, identifying the intrinsic logical relationships of the system elements, as well as realizing the hierarchical analysis of the system structure [55]. The detailed calculation process is described in the study by Xi-Nan Zhao et al. [56].

The specific research steps of this paper are shown in Figure 2.

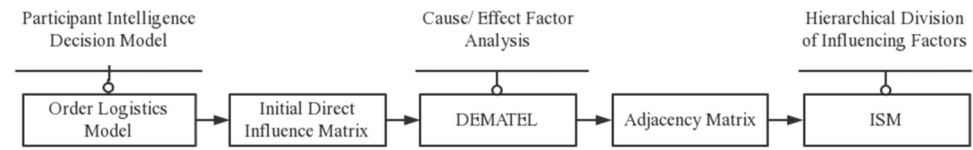


Figure 2. Research framework.

3.2. Data Sources

This study selected Jiangsu and Gansu provinces in China as the study areas in the eastern and western regions, respectively. Considering the poorly ordered supply pattern of the geographic diffusion of rural public product supply under the existing system in China, the distance from the provincial capitals was taken into account when selecting the research areas, so Yuzhong and Zhengning counties in Gansu Province and Lishui and Tongzhou districts in Jiangsu Province were included in the research areas (Figure 3). Core project team members traveled to the above regions between June and October 2021 to conduct fieldwork and household interviews. The random sampling method was used to randomly select 6 to 10 townships in each county (district), 4 to 10 administrative villages in each township, and 10 to 30 households in each village according to the village size for interviews. A total of 1200 questionnaires were distributed, excluding some variable vacancies and inconsistent questionnaires, and 939 valid questionnaires were obtained, of which 518 were from the Jiangsu region and 421 were from the Gansu region. In the survey sample, 34.40% of the respondents indicated that they did not classify domestic waste, 40.58% classified domestic waste into two categories, and 21.51% and 3.51% classified it into 3 and 4 categories, respectively. This result aligns with the current status quo: domestic waste in rural areas is mainly unclassified and second-classified [57]. It also reflects the high representativeness and credibility of the survey data.

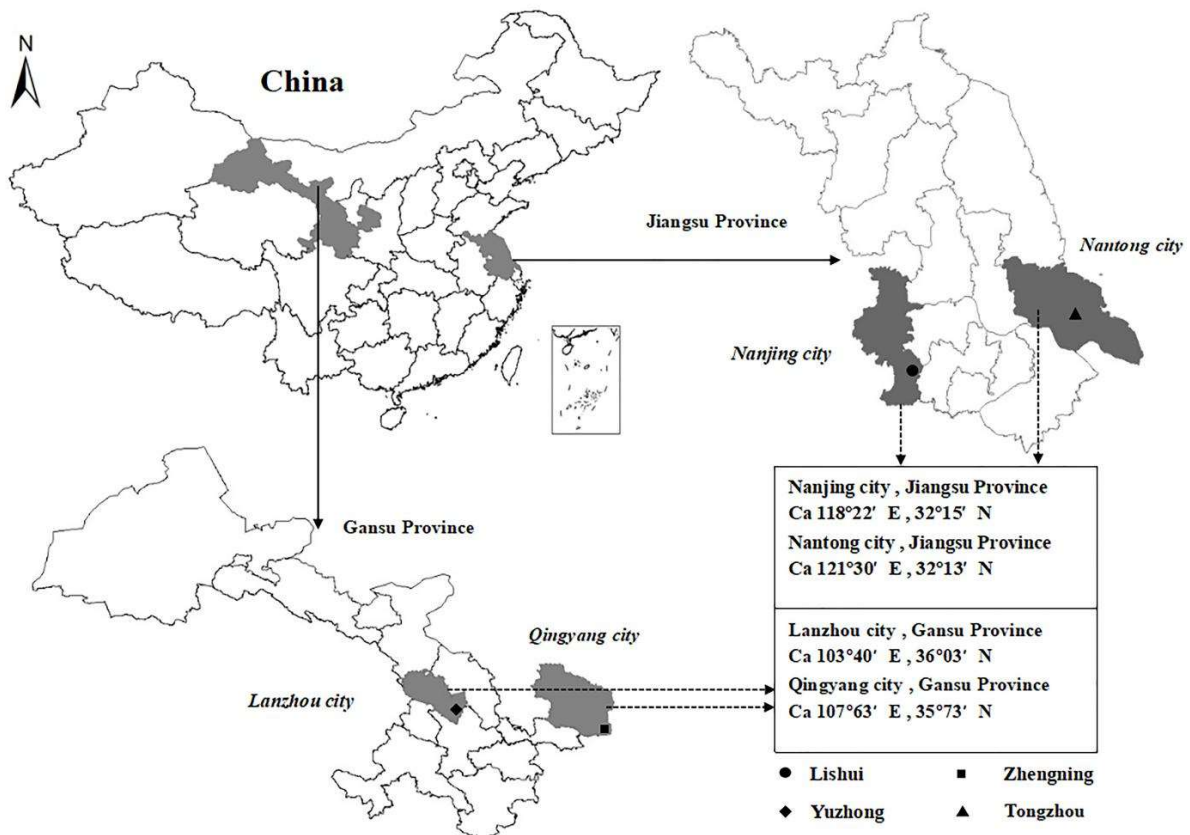


Figure 3. Geographical location of the study area.

3.3. Variable Settings and Statistical Characteristics

3.3.1. Farmers' Behavior in Classifying Domestic Waste

Farmers classify the waste generated in their households' daily lives according to certain criteria, such as the two-classified criteria of recyclable and non-recyclable waste; the three-classified criteria of recyclable, perishable, and residual waste; and the four-classified criteria of recyclable, kitchen waste, hazardous waste, and residual waste. This paper draws on the study of Jia [40]. It combines the research situation to measure the farmers' classification behavior by their level of domestic waste classification. The descriptive statistics of the variables are shown in Table 1.

Table 1. Variable definition and expected impact direction.

Variable		Connotation Interpretation	Mean	Standard Deviation	Expected Direction	
Classification of domestic waste	RC	How many categories do the respondents classify their domestic waste when they throw it away?	1.941	0.834		
Natural attributes	N1	Distance from the village to the county seat (km)	24.696	13.366	-	
Participant Status	personal characteristic	I1	sex (male = 1; female = 0)	0.494	0.5	?
		I2	age (<18 = 1; 18–25 = 2; 26–30 = 3; 31–40 = 4; 41–50 = 5; 51–60 = 6; >60 = 7)	4.907	1.531	-
		I3	Whether a member of the CPC (Yes = 1; No = 2)	1.902	0.297	+
	Governance attitude	A1	Rural waste, sewage, and village appearance need to be addressed (Likert 5-point scale; the higher the value, the better the attitude of farmers to address the issue)	4.294	0.735	+
		A2	Rational segregation and disposal of domestic waste protects the environment and is good for health (ibid.)	3.994	0.955	+
		A3	Village sanitation depends on everyone's self-consciousness (ibid.)	3.741	1.024	+
	Environmental emotion	V1	Participation in environmental management is pleasant (Likert 5-point scale; the higher the value, the stronger the environmental sentiment of the farmers)	3.471	1.017	+
		V2	Uneasy about not participating in environmental governance (ibid.)	3.529	1.024	+
		V3	Participation in environmental governance is recognized and applauded by all (ibid.)	3.065	1.017	+
	Perception of difficulty	T	How difficult it is for you to sort waste (Likert 5-point scale; the higher the value, the more difficult it is)	3.748	1.014	-
Conditional control	Family background	F1	Total family population	4.25	1.271	?
		F2	Highest level of education in the family (illiterate = 1; not educated but literate = 2; elementary school = 3; middle school = 4; high school = 5; college = 6; graduate = 7)	4.457	1.314	+
		F3	What is the level of household income in the village (5-point Likert scale; the higher the value, the higher the level of income in the village)	2.984	0.64	+
Community attributes	S1	Neighborhood trust level (Likert 5-point scale; the higher the value, the higher the level of trust)	3.999	0.739	+	
	S2	Whether the village has been assessed as a demonstration village (Yes = 1; No = 2)	1.722	0.448	+	
	S3	Level of trust in village cadres (Likert 5-point scale; the higher the value, the higher the level of trust).	3.351	0.991	+	

Table 1. Cont.

Variable		Connotation Interpretation	Mean	Standard Deviation	Expected Direction	
Operating rules	R1	Availability of incentives and disincentives (Yes = 1; No = 2)	1.597	0.49	+	
	R2	Current charges for waste management in the village (RMB/month)	6.121	13.813	-	
	R3	Whether there are village rules and regulations (Yes = 1; No = 2)	1.497	0.5	+	
	R4	Waste transport in the village (no unified transport = 1; mixed transport not timely = 2; mixed transport timely = 3; sorted transport not timely = 4; sorted transport timely = 5)	3.18	1.135	+	
Awareness of the current situation	Instrument support	O1	The government provides funds for remediation and improves supporting infrastructure (Likert 5-point scale; the higher the value, the higher the level of perceived support).	3.606	0.932	?
		O2	The government and the village committee will provide publicity and guidance and organize and mobilize villagers to participate in waste separation and environmental protection (ibid.)	3.354	1.095	+
	Emotional support	E1	The government and village committee will try their best to solve the difficulties encountered by villagers in waste separation (ibid.)	3.369	1.134	+
		E2	The government and village committee will pay attention to the actual needs of villagers in waste separation and respect their opinions (ibid.)	2.423	0.913	+
External action situation	Social norm of reference	B	The number of villagers involved in waste classification in this village (Likert 5-point scale, the larger the value, the more people become involved)	3.468	1.165	+
Expected outcomes		EXP	Environmental improvement effect (Likert 5-point scale, the larger the value, the better the expected governance effect)	3.948	0.864	+
Control variable	Regional disparity	AC	East and West (dummy variable; Eastern = 1; Western = 2)	1.448	0.497	+

3.3.2. Natural Attributes

The sample villages sampled in this paper belong to different provinces and counties, with substantial differences in geographic location, geomorphological environment, and socio-economic aspects. This paper selects the distance from the village to the county town and regional disparity to characterize the natural attribute variables for control.

3.3.3. Participant Status

According to the theoretical analysis, this paper characterizes the individual characteristics of participants in terms of gender, age, and Party membership. Party membership is whether the interviewed farmers are members of the Communist Party of China (CPC). The reason for choosing the Party membership variable is that Party members are obligated to play a pioneering and exemplary role in production, work, study, and social life. In rural areas, those who join the CPC generally have higher comprehensive literacy in the village and will actively correspond to the policies of the Chinese central government. Therefore, whether or not one is a Party member may significantly affect their performance in domestic waste classification.

Governance attitudes reflect farmers' subjective understanding of waste-sorting governance, and this paper designs three questions to examine the perspectives of governance necessity, governance beneficence, and governance conscientiousness, respectively.

Environmental emotion refers to an individual's attitude, experience, or psychological reaction to environmental problems or whether the goal of pro-environmental behavior

meets his or her needs. Drawing on Wang's study [48], three questions were designed to measure participants' positive environmental emotion, negative environmental emotion, and external environmental emotion, respectively.

Difficulty perception reflects the farmers' judgment of their ability to carry out domestic waste sorting. The questionnaire design of each variable is shown in Table 1, and a five-point Likert scale was used to assign values.

3.3.4. Conditional Control

According to the theoretical analysis in the previous section, conditional control is mainly characterized by household characteristics. This paper measures three indicators, namely, the total number of household members, the household's average educational level, and the household's economic level.

3.3.5. Community Attributes and Operating Rules

According to previous theoretical analyses, good community attributes generally include a high level of identification with the community, a high level of trust in the community, and access to a high level of community resources. In this paper, we construct 'trust in village cadres', 'trust in the neighborhood', and 'demonstration village or not' to measure community attributes. The reason for choosing the variable of whether it is a demonstration village or not stems from China's unique rural governance system. Demonstration villages are representative and exemplary in the rural revitalization strategy. These villages have made remarkable economic, social, cultural, and ecological achievements and have become role models for other villages to study and learn from. Demonstration villages can attract more resources and capital investment. The competitive advantage of resources in demonstration villages can effectively reduce the resource constraints on collective action, promote the formation of collective action in the community, and increase the motivation of farmers to classify domestic waste.

Operating rules are the codes of conduct and institutional norms that motivate or constrain participants to classify, and in this paper, we encompass four dimensions: incentives and penalties; fee system; village rules and regulations; and household waste transportation.

3.3.6. Perceived Status Quo

When measuring the variables of perceived status quo, government support and behavior are directly related to the participant's perception of classification status quo. Accordingly, this paper designed four questions to measure farmers' perceptions of instrumental support and emotional support, respectively. The questionnaire item design of each variable is shown in Table 1, and a five-point Likert scale is used to assign values.

3.3.7. External Action Situation

According to the previous theoretical analysis, this paper uses the social reference norm variable to characterize the external action situation of the domestic waste classification of farmers. It draws on the study of Xue Caixia et al. [35] to design the measurement item of the number of villagers participating in waste classification in this village.

3.3.8. Expected Outcomes

In this paper, we designed the environmental improvement effect measurement item to measure the expected outcomes and used the Likert five-level scale to assign values.

4. Results

This paper uses the econometric analysis software SPSS23.0 to process the data of 939 samples for ordered logistic regression. The hypothesis conditions of the model were tested before regression, and the results show that the VIF values of all independent variables in this paper are between 1 and 5; $\chi^2 = 0$; $p = 1.000 > 0.05$, indicating that there is no multicollinearity among the independent variables, and the model accepts the original

hypothesis of parallelism. In addition, the results of the likelihood ratio test of whether the partial regression coefficients of all the independent variables in the model are all 0 show that the -2 log-likelihood estimate of the intercept only is $\chi^2 = 2218.477$; $df = 28$; $p = 0.000 < 0.05$, which means the original hypothesis is rejected. This model contains at least one factor that affects the behavior of farmers in the domestic waste classification. The above test results show that using an ordered logistic model in this paper to study factors influencing the domestic waste classification of farmers is statistically significant.

4.1. Factors Influencing Farmers’ Domestic Waste Classification Behavior

Considering all variables for the ordered logistic model regression, the regression coefficients, standard errors, significance levels, and odds ratio of each variable are shown in Table 2. The results show that 17 factors, S2, S3, R1, R2, R4, O2, E1, E2, I3, T, A3, V1, V2, V3, B, EXP, and AC, have statistically significant effects on the domestic waste classification of farmers, which is basically in the expected direction.

Table 2. Regression results on domestic waste classification of farmers.

Variable	Estimation Coefficient	Standard Error	Significance	OR	Variable	Estimation Coefficient	Standard Error	Significance	OR
N	−0.178	0.262	0.497	0.837	I2	0.130	0.129	0.313	1.139
S1	−0.200	0.296	0.500	0.819	I3: Party = 1	2.071	0.585	0.000	7.933
S2: Demonstration village = 1	1.190	0.352	0.000	3.287	I3: Masses = 2	0a			
S2: Non-demonstration village = 2	0a				T	−1.416	0.264	0.000	0.243
S3	0.752	0.296	0.011	2.121	A1	−0.446	0.303	0.142	0.640
R1: Incentive measures = 1	2.674	0.442	0.000	14.498	A2	0.071	0.352	0.841	1.074
R1: No incentive measures = 2	0a				A3	0.858	0.336	0.011	2.358
R2	−0.054	0.017	0.002	0.947	V1	0.757	0.287	0.008	2.132
R3: Village rules and regulations = 1	0.427	0.568	0.453	1.533	V2	0.596	0.254	0.019	1.815
R3: No village rules and regulations = 2	0a				V3	0.640	0.213	0.003	1.896
R4	1.560	0.243	0.000	4.759	F1	−0.201	0.163	0.218	0.818
O1	−0.084	0.295	0.775	0.919	F2	−0.094	0.237	0.690	0.910
O2	0.791	0.258	0.002	2.206	F3	0.292	0.388	0.452	1.339
E1	1.008	0.295	0.001	2.740	B	0.738	0.283	0.009	2.092
E2	1.146	0.243	0.000	3.145	EXP	0.589	0.299	0.049	1.802
I1: Female = 0	−0.084	0.369	0.820	0.919	AC: Eastern = 1	2.398	0.431	0.000	11.001
I1: Male = 1	0a				AC: Western = 2	0a			
No classification	21.305	3.320	0.000	—					
Two categories	41.018	4.460	0.000	—					
Three categories	51.202	4.940	0.000	—					

The regression coefficients (B) of R2 and T are negatively significant, indicating that the higher the waste management fee, the greater the perceived difficulty of waste classification by farmers and the more unfavorable it is for farmers to adopt more classification, thus verifying the research hypothesis H2c.

The regression coefficients of the rest of the significant variables are positive, indicating that the higher the level of these variables, the more helpful it is for farmers to adopt a more detailed way of waste classification, thus verifying research hypotheses H1, H2a, H2b, H3, H4, H6, and H7.

It is worth noting that the empirical results of instrumental support, such as distance from the county town, financial input from the government, and infrastructure, were not significant. That means that research hypothesis H5 was not fully verified and that the direction of the effect of perceived instrumental support varied according to the differences in the content of the support. The non-significance of instrumental organizational support variables such as financial inputs and infrastructure may be due to the positive and negative offsetting of induced and crowding-out effects.

For a more intuitive analysis of the dominance ratios (OR values) of each significantly influential variable, this paper visualizes the OR values of the significantly influential variables in the above regression results (Figure 4).

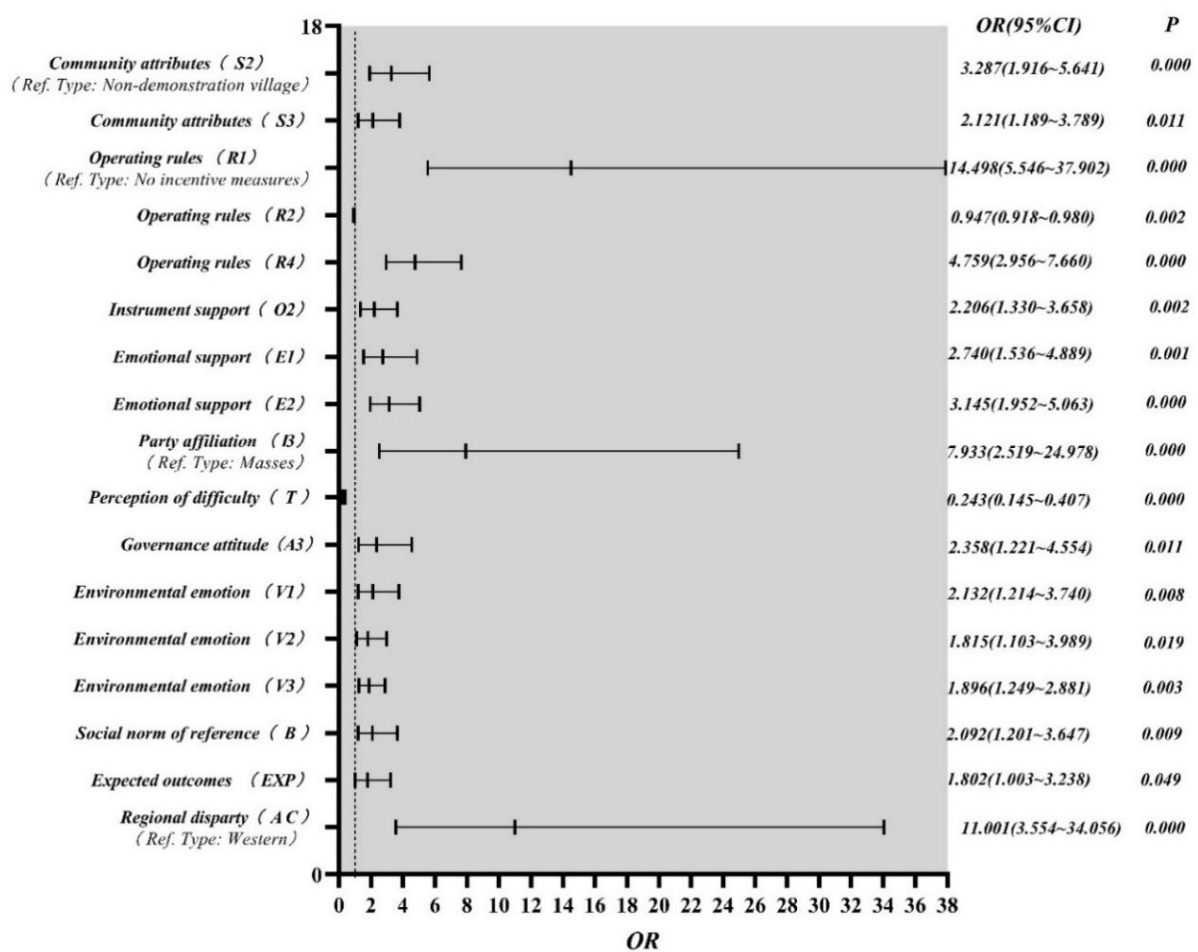


Figure 4. OR of factors influencing domestic waste classification of farmers.

For the dichotomous variables in this study, the probability of farmers in a demonstration village adopting a multiclassification approach is 3.287 times higher than that of farmers in a non-demonstration village. The probability of farmers in villages with incentives and penalties adopting a multiclassification approach is 14.498 times higher than that of farmers in villages without incentives and penalties. The probability of Party members adopting a multiclassification approach is the masses' 7.933 times. The probability of a farm household adopting a multi-categorical approach is 11.001 times higher in the eastern region than in the western region.

For continuous variables, trust in village cadres, for example, has an OR of 2.121, implying that for every unit increase in the level of trust in village cadres, the probability of adopting a more detailed classification method increases by 112 percent. For waste transportation methods, publicity and mobilization type of instrumental support, emotional support to try to solve difficulties, emotional support to respect the need for opinions, conscientious attitude to governance, personal environmental emotions, external action situations, and expected outcomes, the probability of farmers adopting a more refined classification method increases by 375.9%, 120.6%, 174.0%, 214.5% for each unit increase in the level of trust in village cadres, 135.8%, 113.2%, 81.5%, 89.6%, 109.2%, and 80.2%. These estimation results show that supporting the corresponding infrastructure for waste separation, respecting the voices and actual needs of the participants in the system design, and practically solving the difficulties in their participation are the more effective policy measures to motivate farmers to participate in waste separation activities.

It is also worth noting the estimation results of the fee situation and perceived difficulty, with an OR of 0.947 for the fee situation, implying that for every unit increase in the fee level, the probability of farmers adopting a more refined classification method will decrease by 5.3%. Consistent with the previous analysis, for rural waste treatment, there should be a greater preference for on-site rural reduction, resource-based, and non-hazardous treatment to reduce treatment costs for both farmers and the government. The OR of difficulty perception is 0.243, indicating that for every unit increase in the difficulty perception of farmers, the probability of farmers adopting a finer classification method will decrease by 75.7%. This result suggests that localities should adopt simpler and more convenient ways of waste separation and resource treatment appropriate to the location and strengthen education and training on waste separation skills for farmers.

4.2. Causal Association Characterization Based on DEMATEL

Based on the regression results of the ordered logistic model, 17 factors significantly influencing the domestic waste farmers' classification behavior were screened. Five experts in the field of rural governance and rural regional development were invited to score the interactions among the causal factors of the farmers' classification behavior according to a Likert five-point scale, and a direct influence matrix **K** was obtained:

$$\mathbf{K} = \begin{matrix} S_2 \\ S_3 \\ R_1 \\ R_2 \\ R_4 \\ O_2 \\ E_1 \\ E_2 \\ I_3 \\ T \\ A_3 \\ V_1 \\ V_2 \\ V_3 \\ B \\ EXP \\ AC \end{matrix} \begin{bmatrix} 0 & 3 & 4 & 4 & 4 & 4 & 4 & 5 & 0 & 3 & 2 & 2 & 2 & 2 & 2 & 3 & 0 \\ 0 & 0 & 1 & 1 & 0 & 3 & 3 & 3 & 0 & 0 & 3 & 0 & 0 & 0 & 1 & 2 & 0 \\ 2 & 3 & 0 & 4 & 0 & 5 & 4 & 4 & 0 & 0 & 3 & 4 & 5 & 5 & 5 & 4 & 0 \\ 2 & 3 & 2 & 0 & 5 & 3 & 3 & 3 & 0 & 2 & 2 & 4 & 4 & 4 & 4 & 4 & 0 \\ 3 & 2 & 3 & 4 & 0 & 1 & 4 & 4 & 0 & 0 & 2 & 2 & 1 & 1 & 3 & 3 & 0 \\ 0 & 2 & 3 & 4 & 2 & 0 & 4 & 4 & 0 & 4 & 2 & 3 & 3 & 3 & 4 & 3 & 0 \\ 0 & 5 & 2 & 2 & 4 & 5 & 0 & 5 & 0 & 5 & 2 & 4 & 4 & 4 & 5 & 4 & 0 \\ 0 & 5 & 2 & 3 & 4 & 5 & 5 & 0 & 0 & 5 & 3 & 4 & 5 & 4 & 5 & 4 & 0 \\ 0 & 4 & 0 & 0 & 1 & 3 & 2 & 2 & 0 & 2 & 5 & 3 & 4 & 4 & 0 & 3 & 0 \\ 0 & 0 & 3 & 4 & 4 & 2 & 2 & 2 & 0 & 0 & 2 & 1 & 2 & 2 & 1 & 2 & 0 \\ 2 & 0 & 1 & 3 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 2 & 2 & 2 & 3 & 2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 3 & 0 & 4 & 5 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 3 & 4 & 0 & 5 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 3 & 4 & 4 & 0 & 2 & 0 & 0 \\ 0 & 0 & 3 & 4 & 3 & 3 & 2 & 3 & 0 & 3 & 3 & 3 & 4 & 4 & 0 & 3 & 0 \\ 3 & 3 & 2 & 2 & 3 & 3 & 3 & 3 & 0 & 1 & 2 & 2 & 3 & 3 & 4 & 0 & 0 \\ 2 & 0 & 4 & 4 & 4 & 4 & 5 & 4 & 0 & 3 & 2 & 2 & 2 & 2 & 2 & 3 & 0 \end{bmatrix}$$

On this basis, we calculated the centrality and causality of each influencing factor using Matlab22.0 software and visualized them (Figure 5).

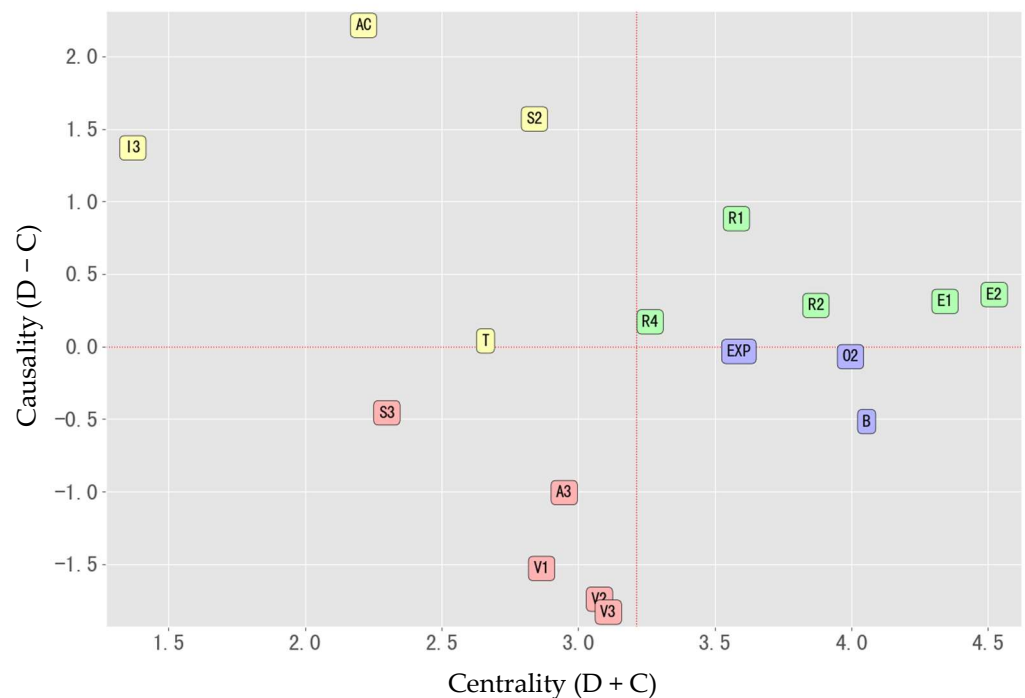


Figure 5. Causal diagram of factors influencing domestic waste classification of farmers. Note: The yellow group variables indicate high causality and low centrality. The green group variables indicate high centrality and high causality. Variables in purple represent high centrality and low causality. Variables in red indicate low centrality and low causality. D is the degree of influence, and C is the degree of being influenced. It is obtained from matrix K after a series of calculations using the DEMATEL method, and the specific formula is shown in the paper by Xi-Nan Zhao et al. [56].

Centrality indicates the position of the factor in the evaluation system and the size of the role it plays, and the centrality of a factor is the sum of its influencing degree and the degree of being influenced. The larger the value of the centrality degree, the greater the driving role played by the factor in the classification of agricultural household waste. Causality is obtained by subtracting the degree of influence and the degree of being influenced by a certain element. The larger the value of the cause degree, the stronger the correlation of the factor. When the cause degree is greater than 0, it indicates that the factor has a greater influence on other factors, which is called the cause factor; when the cause degree is less than 0, it indicates that the factor is more influenced by other factors, which is called the result factor.

In terms of centrality, the factors influencing the domestic waste classification of farmers are as follows, in order of importance: organizational support; social reference norms; operational rules; expected outcomes; environmental emotions; government attitudes; regional disparity; and community atmosphere. Specifically, the centrality values of eight factors, namely, incentives and sanctions, fee collection, transportation of waste within the village, emotional and organizational support received by farmers in waste classification matters, publicity and mobilization instrumental support, participation of others, and expected outcome of waste classification, were relatively high, indicating that they had a more significant impact on farmers' classification behavior.

In terms of causality, the nine factors of incentives and penalties, the situation of charging fees, the situation of transporting waste in the village, the perception of emotional support that farmers receive in waste classification affairs, the perception of difficulty, whether or not it is a demonstration village, the regional disparity, and the Party affiliation are the cause factors, and their degree of importance is in the following order: the regional disparity; the demonstration village; the Party affiliation; the operating rules; and emotional support. The outcome factors were the eight factors of village cadre trust, perceived support

of publicity and mobilization tools, conscious governance attitude, environmental emotion, participation of others, and expected improvement effect. Of these, other factors influenced conscious governance attitude and personal environmental emotion more.

That is to say, guaranteeing the operating rules of waste governance and the organizational support of the government and the village committee plays an influential role in involving farmers in waste classification and in correlation with other influencing factors. They also show a significant influence on the formation of governance attitudes and environmental emotions toward the waste classification of farmers. It also has a good orientation toward the variables of trust in the village cadres and the expected outcomes of classification.

4.3. Characterization of Causal Hierarchy Based on ISM

According to the direct influence matrix *K*, Matlab22.0 software is applied to calculate the reachable matrix *Z*, which calculates the reachable set, antecedent set, and intersection set and divides the reachable matrix to obtain the skeleton matrix.

$$\mathbf{Z} = \begin{matrix} S_2 \\ S_3 \\ R_1 \\ R_2 \\ R_4 \\ O_2 \\ E_1 \\ E_2 \\ I_3 \\ T \\ A_3 \\ V_1 \\ V_2 \\ V_3 \\ B \\ EXP \\ AC \end{matrix} \begin{bmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 0 & 1 & 1 & 1 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix}$$

According to the principle of hierarchical division, the region and the interlevel decomposition method determine the hierarchical structure of each influential factor and derive the association and hierarchical structure among the factors, as shown in Figure 6.

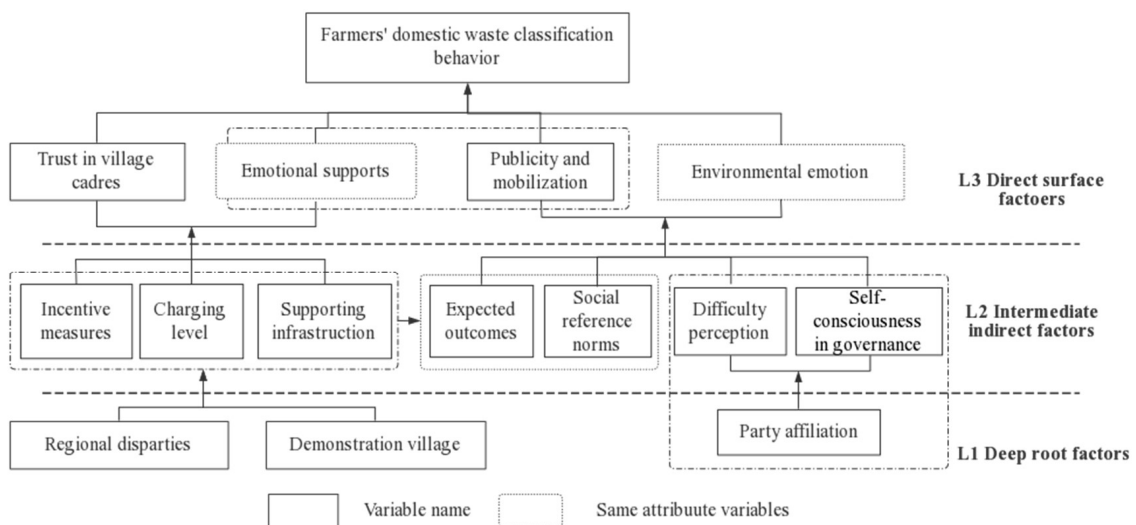


Figure 6. Relational and hierarchical structure of the influencing factors.

As can be seen in Figure 5, in the multilayer hierarchical structural model of the influencing factors of rural waste classification, trust in village cadres, perceived instrumental support of publicity and mobilization, perceived emotional support of the government and village committees to pay attention to the rights and needs of farmers, and perceived emotional support of solving the practical difficulties of farmers, as well as the environmental emotions of farmers are the superficial direct factors. The operating rules such as incentives and penalties and fee collection, the perceived difficulty and conscientiousness of farmers' attitudes toward governance, the social reference norms, and external action situations characterized by the expected outcomes of waste classification are middle-level indirect factors. Whether or not it is a demonstration village, whether or not it is a Party member, and geographical differences are deep-rooted factors. The deep-rooted causes act on the surface direct factors by influencing the middle indirect factors. It can be seen that current regional characteristics and demonstration village community attributes directly determine the operating rules of rural waste classification and management, and the operating rules situation also influences farmers' trust in village cadres and their perception of the emotional support provided by the government and the village committee. Combined with the impact of farmers' expected outcomes of domestic waste classification and governance and social reference norms on environmental sentiments and perceived instrumental support for publicity, education, and organizational mobilization of the government and village committees. Party and government status has a direct impact on farmers' attitudes toward conscious governance and the perceived difficulty of waste classification. Ultimately, farmers' level of trust in village cadres, perceived organizational support, and personal environmental emotions directly impact their waste classification behavior.

5. Discussion

The mandatory promotion of waste classification contributes to increasing the recycling rate of resources, reducing the risk of supplying critical raw materials [58], and reducing the human and material costs required for back-end waste disposal [59,60]. According to the results of the analysis of influencing factors, we found that individual characteristics, family status, difficulty perception, governance attitude, environmental emotions, community attributes, operating rules, perception of the current situation, external action situation, and expected outcomes have an impact on the farmers' classification behavior, which is more consistent with the findings of existing studies [61–63]. The core factors affecting the waste farmers' classification behavior are mainly regional disparity, demonstration village, Party affiliation, operating rules, and emotional support perception; i.e., the key to activating the endogenous motivation of farmers to participate in waste classification from the root is based on the construction of a system that is reasonable, scientific, standardized, and meets the needs of farmers and respects their opinions. The political profile is consistent with the findings of existing studies [64], indicating the important role of members of the political elite in providing public goods in rural areas.

The distance from the county town is insignificant, which aligns differently with expectations. Based on the characteristics of China's hierarchical management system and the differential order pattern, it is reasonable to assume that the closer the village is to the county town, the more attention and resources can be invested in rural environmental governance, which may positively affect the farmers' classification behavior. However, the closer to the county town, the more the local government may tend to incorporate rural waste treatment into the urban system, which will reduce the requirements of waste classification and source emission reduction for farmers and reduce the awareness of the responsibility of waste classification of farmers, so the effect of the distance factor should be considered separately depending on the reality. Meanwhile, the empirical results of perceived instrumental support, such as government financial input and infrastructure supply, are not significant, and the failure of such measures may be due to the positive and negative offsetting of the induced and crowding effects. However, the promotion effect of publicity, education, and organizational mobilization is positive and significant,

indicating differences in the effects of different support contents on farmers' classification behavior. Despite the results of Han G et al.'s study showing that government financial inputs are beneficial to farmers' willingness to separate domestic waste and their separation behavior [64], the results of farmers' perception of the impact of incentivizing and enabling financial inputs on their behavior in the management of domestic waste separation were very different due to different psychological motivations. The facilitating effect of publicity, education, and organizational mobilization was positive and significant. The above findings suggest differences in the impacts of different government support components on farmers' sorting behavior, and thus, the policy effects of the "combined punch" of government support need to be further investigated.

Relative to previous research, this paper has the following new findings. First, the superficial factors affecting the domestic waste classification of farmers, such as improving the trust of village cadres and strengthening government support, can improve the domestic waste classification of farmers more rapidly. Still, we want to improve the sustainability of this behavior. In that case, we must strengthen the optimization of the intermediate and root factors, such as improving the institutional rules and adapting them to the local conditions. Second, after the introduction of government support into the PID model, the findings of this study show that government instrumental support, especially financial input, produces both positive and negative role effects, which leads to insignificant empirical results, a conclusion that is more in line with the current reality of Chinese farmers' lack of environmental responsibility; financial input instead exacerbates the cognitive bias of farmers' roles in the management of waste separation.

6. Conclusions and Implications

6.1. Conclusions

This paper focuses on the crucial role of source separation in domestic waste management. Based on the PID model, it constructs a framework for analyzing the influencing factors of farmers' domestic waste separation behavior. Using 939 samples of farmers obtained from the field research in Gansu and Jiangsu Provinces, this paper organically combines the ordered logistic model and the DEMATEL-ISM to exploratively analyze the influencing factors of the farmers' domestic waste separation behavior and to identify the logical relationship and hierarchical structure between the various aspects.

This study shows the following:

First, farmers in the eastern region, in villages with the title of demonstration village, incentives, penalties, and better-supporting infrastructure for waste separation and management, are more inclined to adopt a more detailed approach to waste separation.

Second, the higher the level of trust in village cadres, the higher the perceived instrumental support (publicity and education, organizational mobilization), and the higher the perceived emotional support (valuing needs and respecting opinions, etc.), the more likely it is that farmers will respond positively to the national policy of implementing waste separation.

Third, farmers' Party membership, perceived awareness of environmental protection, environmental emotions, social reference norms, and expected outcomes all positively affect farmers' classification behavior. The higher the waste management fee, the greater the perceived difficulty of classification, and the more farmers tend to adopt simple classification.

Fourth, trust of village cadres, perceived organizational support, and personal environmental emotions are surface-level direct factors influencing farmers' waste classification behavior; incentives and penalties, fee level, waste transportation situation, perceived difficulty, conscientious attitude toward waste management, social norms, and expected outcomes are middle-level indirect factors. Whether or not it is a demonstration village, the Party membership and geographic differences are deeper-rooted causes influencing farmers' waste classification behavior.

6.2. Implications

Based on the above empirical findings, this paper proposes the following recommendations for countermeasures to promote source classification of domestic waste by farmers.

In terms of practice, firstly, the government should abandon the governance model of taking care of everything and focus on replenishing the conventional infrastructure of rural garbage classification, that is, the supply of public goods that is more difficult to achieve through the cooperation of farmers; secondly, cultivate the strength of grassroots organizations, raise the level of trust of farmers in the grassroots government, and give full play to the demonstrative and extensive mobilization of the grassroots organizations; thirdly, the publicity work should be integrated into the daily life of farmers, enrich the content of the publicity, and focus on awakening farmers' sense of worry and fostering their environmental sentiment.

In terms of system design, firstly, strengthen the pragmatism of the system, combined with local experience, lower the participation threshold of farmers, and increase the recycling rate and resource utilization rate of garbage; secondly, make repeated rehearsals and revisions of the feasibility of the implementation of relevant policy initiatives, the possible performance of policy tools, and the implementation process of the policy program, to ensure that the policy can realize the whole process of closed-loop operation; thirdly, improve the rewards and punishment mechanism, and in addition to designing material rewards, explore non-material rewards, such as the honor mechanism.

6.3. Limitation and Future Work

Although this study achieved some findings, some improvements and limitations still need to be addressed. Firstly, all the variables measured in this paper were self-reported. Although this method is often used in relevant studies and widely accepted by academics, homogeneous data may still introduce systematic bias. Secondly, although this paper has screened out the main factors influencing domestic waste classification of farmers from several factors and sorted out the logical relationship and hierarchical structure between the key variables, the mechanism of the role of each key core factor on domestic waste classification of farmers behavior still needs to be further explored.

In future studies, we can use a combination of self-reported subjective assessments and rural community assessments to obtain these assessments and reduce the possibility of systematic bias. Meanwhile, based on this and other research, the mechanism and effect of critical variables on the domestic waste classification of farmers should be further expanded and analyzed.

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References

- Zhang, X.; He, J.; Wang, X. Distribution, Localization, Resource Utilization, and Micro-Circulation—The Innovative Solution To China's Garbage Treatment. *Adm. Reform* **2021**, *13*, 35–41. [\[CrossRef\]](#)
- Wang, X.; He, J. Research on Promoting Rural Residents' Endogenous Driving Force of Participation in the Environmental Governance: Based on Five Typical Cases. *Ecol. Econ.* **2021**, *37*, 200–206.
- Du, Y.; Liu, N.; Chen, L. An Analysis of Farmers' Collective Inaction in Rural Environmental Governance and Its Turning Logic. *China Rural Surv.* **2021**, *42*, 81–96.
- Lebersorger, S.; Beigl, P. Municipal Solid Waste Generation in Municipalities: Quantifying Impacts of Household Structure, Commercial Waste and Domestic Fuel. *Waste Manag.* **2011**, *31*, 1907–1915. [\[CrossRef\]](#)
- Wan, C.; Shen, G.Q.; Yu, A. Key Determinants of Willingness to Support Policy Measures on Recycling: A Case Study in Hong Kong. *Environ. Sci. Policy* **2015**, *54*, 409–418. [\[CrossRef\]](#)
- Wan, C.; Shen, G.Q. Perceived Policy Effectiveness and Recycling Behaviour: The Missing Link. *Waste Manag.* **2013**, *33*, 783–784. [\[CrossRef\]](#)
- Purcell, M.; Magette, W.L. Prediction of Household and Commercial BMW Generation According to Socio-Economic and Other Factors for the Dublin Region. *Waste Manag.* **2009**, *29*, 1237–1250. [\[CrossRef\]](#)
- Shen, J.; Qu, M.; Zheng, D.; Zhang, Y. Research on the Farmers' behavior of Domestic Waste Source sorting—Based on TPB and NAM Integration Framework. *J. Arid Land Resources Environ.* **2020**, *34*, 75–81. [\[CrossRef\]](#)
- Goh, E.; Esfandiar, K.; Jie, F.; Brown, K.; Djajadikerta, H. Please Sort out Your Rubbish! An Integrated Structural Model Approach to Examine Antecedents of Residential Households' Waste Separation Behaviour. *J. Clean. Prod.* **2022**, *355*, 131789. [\[CrossRef\]](#)
- Sguin, C.; Pelletier, L.G.; Hunsley, J. Toward a Model of Environmental Activism. *Environ. Behav.* **1998**, *30*, 628–652. [\[CrossRef\]](#)
- Liao, B. Family Livelihood Capital, the Recognition and the Behavior of Paying for the Governance of Rural Living Environment for Farmers: Taking 873 Farmers in Jiangxi Province for Example. *J. Agro-For. Econ. Manag.* **2021**, *20*, 598–609. [\[CrossRef\]](#)
- Cai, Q.; Zhu, Y. Social Trust, Relational Networks and Farmers' Participation in Rural Public Goods Supply. *Chin. Rural Econ.* **2015**, *31*, 57–69.
- Phuphisith, S.; Kurisu, K.; Hanaki, K. A Comparison of the Practices and Influential Factors of Pro-Environmental Behaviors in Three Asian Megacities: Bangkok, Tokyo, and Seoul. *J. Clean. Prod.* **2020**, *253*, 119882. [\[CrossRef\]](#)
- Sadeghi, S.; Asadi, Z.S.; Rakhshani, T.; Mohammadi, M.J.; Azadi, N.A. The Effect of an Educational Intervention Based on the Integrated Behavior Model (IBM) on the Waste Separation: A Community Based Study. *Clin. Epidemiol. Glob. Health* **2020**, *8*, 576–580. [\[CrossRef\]](#)
- Tadesse, T.; Ruijs, A.; Hagos, F. Household Waste Disposal in Mekelle City, Northern Ethiopia. *Waste Manag.* **2008**, *28*, 2003–2012. [\[CrossRef\]](#)
- Zaikova, A.; Deviatkin, I.; Havukainen, J.; Horttanainen, M.; Astrup, T.F.; Saunila, M.; Happonen, A. Factors Influencing Household Waste Separation Behavior: Cases of Russia and Finland. *Recycling* **2022**, *7*, 52. [\[CrossRef\]](#)
- Breitenmoser, L.; Behner, D.; Baertsch, A.; Mondardini, M.R.; Hugi, C. Citizen Science-Based Waste Diaries: An Exploratory Case Study of Household Waste in Switzerland. *Sustainability* **2024**, *16*, 3800. [\[CrossRef\]](#)
- Allison, E. The Reincarnation of Waste: A Case Study of Spiritual Ecology Activism for Household Solid Waste Management: The Samdrup Jongkhar Initiative of Rural Bhutan. *Religions* **2019**, *10*, 514. [\[CrossRef\]](#)
- Zuo, X.; Kang, M.; Lu, J. The impact of social interaction and Internet use on rural residents' willingness to sort domestic waste. *Resour. Sci.* **2022**, *44*, 47–58. [\[CrossRef\]](#)
- Jia, Y.; Zhao, M. Farmers' Preference for Source Classification of Domestic Waste. *J. Arid Land Resour. Environ.* **2021**, *35*, 40–47. [\[CrossRef\]](#)
- Liu, Y.; Zhu, H.; Zhang, L. Can Information Intervention Improve the Effectiveness of Farmers' Waste Classification: Evidence from a Farmers' Behavior Experiment in the Taihu Lake Basin. *J. Agrotech. Econ.* **2023**, *42*, 112–126. [\[CrossRef\]](#)
- Zhang, B.; Lai, K.; Wang, B.; Wang, Z. From Intention to Action: How Do Personal Attitudes, Facilities Accessibility, and Government Stimulus Matter for Household Waste Sorting? *J. Environ. Manag.* **2019**, *233*, 447–458. [\[CrossRef\]](#) [\[PubMed\]](#)
- Field, B.C.; Ostrom, E. Governing the Commons: The Evolution of Institutions for Collective Action. *Land Econ.* **1992**, *68*, 354. [\[CrossRef\]](#)
- Ostrom, E. Building a Better Micro-Foundation for Institutional Analysis. *Behav. Brain Sci.* **2005**, *28*, 831–832. [\[CrossRef\]](#)
- Wang, Y.; Shu, Q. Review and Prospect of Collective Action Studies on Commons Governance. *China Popul. Environ.* **2021**, *31*, 118–131.
- Cao, Y.; Wu, C.; Zhu, Y. Farmers Land Expropriation Willingness Based on IAD Extension Decision Model. *Econ. Geogr.* **2015**, *35*, 141–148. [\[CrossRef\]](#)
- Liu, M. Reform of the Collective Forest Rights System: A Study of Farmers' Planting Intentions—Based on Elinor Ostrom's IAD Extension Model. *J. Manag. World* **2011**, *212*, 93–98. [\[CrossRef\]](#)
- Mairizal, A.Q.; Sembada, A.Y.; Tse, K.M.; Rhamdhani, M.A. Electronic Waste Generation, Economic Values, Distribution Map, and Possible Recycling System in Indonesia. *J. Clean. Prod.* **2021**, *293*, 126096. [\[CrossRef\]](#)
- Abbondanza, M.; Souza, R.G. Estimating the Generation of Household E-Waste in Municipalities Using Primary Data from Surveys: A Case Study of Sao Jose Dos Campos, Brazil. *Waste Manag.* **2019**, *85*, 374–384. [\[CrossRef\]](#) [\[PubMed\]](#)

30. Wang, B.; Yang, F.; Wang, Y. Farmers' Participation in Improving Living Environment from the Perspective of Environmental Literacy. *J. Agro-For. Econ. Manag.* **2021**, *20*, 740–748. [CrossRef]
31. Zhu, H.; Shan, H.; Shen, Y.; Zhang, L.; Zhou, Y. The Influence of Digital Literacy on Villagers' Waste Classification Willingness and Behaviour. *J. Jiangsu Univ. Sci. Ed.* **2022**, *24*, 35–53. [CrossRef]
32. Mirza, K.; Abubakir, H. Feasibility of Solid Waste Sorting in Soran Bazaar, Iraqi Kurdistan. 2023. Available online: https://www.researchgate.net/profile/Khadijeh-Mirza/publication/370510390_Feasibility_of_solid_waste_sorting_in_Soran_bazaar_Iraqi_Kurdistan/links/6453c11e97449a0e1a77c7c8/Feasibility-of-solid-waste-sorting-in-Soran-bazaar-Iraqi-Kurdistan.pdf (accessed on 12 May 2024).
33. Matiuk, Y.; Liobikienė, G. The Impact of Informational, Social, Convenience and Financial Tools on Waste Sorting Behavior: Assumptions and Reflections of the Real Situation. *J. Environ. Manag.* **2021**, *297*, 113323. [CrossRef] [PubMed]
34. Zhang, Y.; Wan, X. Study on the Influence of the Personal Norms and Social Norms on the Urban Residents' Participation in Garbage Sorting. *Resour. Environ. Yangtze Basin* **2021**, *30*, 1714–1723.
35. Xue, C.; Yao, S.; Li, H. Study of Impact of Environmental Emotions and Skills on Pro—Environmental Behaviors of Tea Growers in Qinba Mountain Area. *Resour. Environ. Yangtze Basin* **2021**, *30*, 2287–2298.
36. Wang, J. The Dimensional Structure of environmental emotion and its influence on consumption carbon emission reduction behavior: The two-factor theory hypothesis of emotion-behavior and its verification. *J. Manag. World* **2015**, *31*, 82–95. [CrossRef]
37. Siwar, C.; Hossain, M.A. The Impact of Household Income on Waste Minimization: A Case Study of Kuching City, Sarawak. In *Policies to Improve Municipal Solid Waste Management*; Institut Alam Sekitar dan Pembangunan (LESTARI): Bangi, Malaysia, 2001. Available online: <https://agris.fao.org/search/en/providers/122640/records/64738d3868b4c299a3f880a2> (accessed on 14 May 2024).
38. Liao, M. How Does Community Assimilation Affect Domestic Waste Sorting Behavior in Beijing? *China Popul. Environ.* **2020**, *30*, 118–126.
39. Tang, H. Research on the Garbage Classification Behaviour in the Improvement of Rural Habitat Environment—Based on the Survey Data from Sichuan Province. *J. Southwest Univ. Sci. Ed.* **2020**, *42*, 1–8. [CrossRef]
40. Jia, Y.; Zhao, M. Willingness and behavior of household rural household garbage classification and treatment. *J. Arid Land Resour. Environ.* **2020**, *34*, 44–50. [CrossRef]
41. Xu, L.; Ling, M.; Lu, Y. Key Determinants of Urban Household Solid Waste Recycling Behavior. *J. Public Manag.* **2017**, *14*, 142–153+160. [CrossRef]
42. Mcmillan, D.; Chavis, D. Sense of Community: A Definition and Theory. *J. Community Psychol.* **1986**, *14*, 6–23. [CrossRef]
43. Zhou, Y.; Wang, Y. Social Identity, Preference and Economic Behavior: Based on the Reviews of the Research Findings of Behavior and Experimental Economics. *South China J. Econ.* **2016**, *34*, 95–105. [CrossRef]
44. Jiang, L.; Zhao, X. Classified Treatment Management of Rural Domestic Waste: Model Comparison and Policy Enlightenment Based on a Case Study of Four Ecological Conservation Areas in Beijing. *China Rural Surv.* **2020**, *37*, 16–33.
45. Keizer, K.; Schultz, P.W. Social Norms and Pro-Environmental Behaviour. In *Environmental Psychology: An Introduction*; John Wiley & Sons Ltd.: Hoboken, NJ, USA, 2018; pp. 179–188. [CrossRef]
46. Issock, P.B.I.; Roberts-Lombard, M.; Mpinganjira, M. Normative Influence on Household Waste Separation: The Moderating Effect of Policy Implementation and Sociodemographic Variables. *Soc. Mark. Q.* **2020**, *26*, 93–110. [CrossRef]
47. Yang, L. Building a Multi-Collaborative Community Governance System to Resolve the Dilemma of Collective Action—A Framework of “Product-Institutional” Analysis (PIA). *J. Public Manag.* **2007**, *5*, 6–15+17–23+121–122.
48. Wang, J.; Ding, X.; Li, D.; Li, S. The Impact of Organizational Support, Environmental Health Literacy on Farmers' Willingness to Participate in Rural Living Environment Improvement in China: Exploratory Analysis Based on a PLS-SEM Model. *Agriculture* **2022**, *12*, 1798. [CrossRef]
49. Wang, J. The Influence of Resource-saving Consciousness on Resource-saving Behavior: An Interactive and Moderating Effect Model in the Context of Chinese Culture. *J. Manag. World* **2013**, *29*, 77–90+100. [CrossRef]
50. Meng, F.; Chen, H.; Yu, Z.; Xiao, W.; Tan, Y. What Drives Farmers to Participate in Rural Environmental Governance? Evidence from Villages in Sandu Town, Eastern China. *Sustainability* **2022**, *14*, 3394. [CrossRef]
51. Ma, X.; Ma, J.; Yan, J. Why Citizens Comply: Value Identity and Social Norms in Policy Implementation. *Expand. Horiz.* **2023**, *39*, 121–128.
52. Ostrom, E. Background on the Institutional Analysis and Development Framework. *Policy Stud. J.* **2011**, *39*, 7–27. [CrossRef]
53. Yu, Z.; Wu, C.; Shen, X. Study of Farmers' Willingness for Land Fallow Based on IAD Extension Decision Model. *J. Nat. Resour.* **2017**, *32*, 198–209.
54. Warfield, J.N. Developing Interconnection Matrices in Structural Modeling. *IEEE Trans. Syst. Man Cybern.* **1974**, *SMC-4*, 81–87. [CrossRef]
55. Ma, Y.; Dou, Y. The Key Elements and Construction Strategies of University Entrepreneurship Education Ecosystem Oriented by Ability Cultivating: Empirical Analysis Based on DEMATEL-ISM. *Res. Educ. Dev.* **2022**, *42*, 68–76. [CrossRef]
56. Zhao, X.; Guo, B.; Yang, X.; Zhang, Q. Analysis on the Factors That Influence University Scholars' Academic Entrepreneurship: An Empirical Research Based on the DEMATEL+ISM Combined Method. *Manag. Rev.* **2023**, *35*, 105–117. [CrossRef]
57. Zhu, N.; Qin, F. Difficulties and Solutions of Source Classification of Rural Household Waste. *Environ. Prot.* **2023**, *51*, 49–51. [CrossRef]

58. Santillán-Saldivar, J.; Cimprich, A.; Shaikh, N.; Laratte, B.; Young, S.B.; Sonnemann, G. How Recycling Mitigates Supply Risks of Critical Raw Materials: Extension of the Geopolitical Supply Risk Methodology Applied to Information and Communication Technologies in the European Union. *Resour. Conserv. Recycl.* **2021**, *164*, 105108. [[CrossRef](#)]
59. Colon, M.; Fawcett, B. Community-Based Household Waste Management: Lessons Learnt from EXNORA's "zero Waste Management" Scheme in Two South Indian Cities. *Habitat Int.* **2006**, *30*, 916–931. [[CrossRef](#)]
60. Wyssusek, K.H.; Foong, W.M.; Steel, C.; Gillespie, B.M. The Gold in Garbage: Implementing a Waste Segregation and Recycling Initiative. *AORN J.* **2016**, *103*, 316.e1–316.e8. [[CrossRef](#)] [[PubMed](#)]
61. Bowles, S.; Polania-Reyes, S. Economic Incentives and Social Preferences: Substitutes or Complements? *Dep. Econ. Univ. Siena* **2012**, *50*, 368–425. [[CrossRef](#)]
62. Wang, X.; Zeng, X. Perception, Intention, and Action: An Influencing Path of Urban Residents' Waste Separation Behavior. *J. Nanjing Tech. Univ. Sci. Ed.* **2021**, *20*, 49–64+111–112.
63. Song, Y.; Zhan, Y.; Qi, Y.; Xu, D.; Deng, X. Does Political Participation Influence the Waste Classification Behavior of Rural Residents? Empirical Evidence from Rural China. *Agriculture* **2022**, *12*, 625. [[CrossRef](#)]
64. Han, G.; Zhai, P.; Zhu, L.; Li, K. Economic Incentives, Reputation Incentives, and Rural Residents' Participation in Household Waste Classification: Evidence from Jiangsu, China. *Agriculture* **2023**, *13*, 1931. [[CrossRef](#)]

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